

Umhverfis- og Auðlindaráðuneytið
Borgartúni 26
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10.01.2025

Efni: Umsögn EM Orku - Drög verkefnisstjórnar rammaáætlunar að flokkun tíu vindorkukosta

Frá því að þróun á Vindorkugarði hófst árið 2018 hefur EM Orka tekið þátt í rammaáætlun. Fyrst í 4. áfanga (2017-2021) og nú 5. áfanga (2021-2025). Í millitíðinni hefur fullt umhverfismat framkvæmda verið unnið sem og skipulagsbreyting verið unnin fyrir svæðið og öllum gögnum deilt með verkefnastjórn rammaáætlunar.

Árið 2021 voru niðurstöður 4. áfanga rammaáætlunar að Vindorkugarður í Garpsdal ætti að flokkast í nýtingu ”vegna lágar áhrifaeinkunnir faghópa 1 og 2”.

Sú niðurstaða var viðbúin enda gaf undirbúnungsvinna til kynna að um henturga staðsetningu var að ræða eins og niðurstöður rannsókna umhverfismats staðfestu að lokum.

EM Orka var fyrsti virkjunaraðilinn sem tók þátt í GPS merkingum hafarna í samráði við NÍ og kostaði merking tveggja arnarunga í nálægasta hreiðri við vindorkugarðinn sem var þó í 11,5 km fjarlægð frá mörkum vindorkugarðsins og á móti höfum við fengið aðgang að staðsetningargögnum arna í grennd við framkvæmdarsvæðið.

Þegar staðsetning ofan á Garpsdalsfjalli var valin var haft í huga hegðunarmynstur og eðli hafarnarins.

Búsvæði:

“Haförn finnst í fjölbreyttum búsvæðum en eru yfirleitt nátengdir vatni og vex yfirleitt á láglendi.^[12] [...] Á strandsvæðum getur tegundin verið allt frá háum [sjávarklettum](#) niður í láglendar [eyjar](#) og [eyjaklasa](#). Sérstaklega á veturna koma margir hafarnir oft á lága strandstaði, [árósa](#) og [strandmýrar](#). Nokkrar rannsóknir hafa stutt að strandsvæði séu ákjósanlegastar þegar það stendur til boða á veturna.^{[12][5][89]} “

https://en.wikipedia.org/wiki/White-tailed_eagle#Habitat

Fæða og fæðuhættir:

“Örninn veiðir sér til matar og er aðalbráðin fyll sem hann tekur á flugi, æðarfugl tekur hann á sjó og fiskur (hrognkelsi, laxfiskar) sem hann grípur við yfirborð. Lundi og máfar eru einnig teknir. Hann etur gjarnan hræ og rænir stundum æti frá öðrum fuglum.”

“Ernir eru bæði klárir og latir og þeir munu glaðir stela frá öðrum.”

<https://fuglavefur.is/birdinfo.php?val=2&id=52>

Lega landsins og aðstæður uppi á Garpsdalsfjalli gefa til kynna að það sé ekkert uppi á Garpsdalsfjalli sem trekkir erni að enda greindust engir erni innan marka vindorkugarðsins, hvorki frá sjónhólmælingum né GPS mælingum, frá upphafi mælinga 2019 til loka árs 2022.

Núna hefur hins vegar 5. áfangi rammaáætlunar flokkað vindorkugarð í Garpsdal hins vegar í bið vegna þess að ný gögn sýna að *”hafarnir fljúga í einhverjum tilvikum nálægt og mögulega yfir mögulegt virkjunarsvæði í Garpsdal.”* og að vindorkugarður í Garpsdal verði í biðflokk *”á meðan þeirri óvissu er eytt.”* En í skýrslu faghóps 1 segir: “Ernir sáu ekki fljúga yfir Garpsdal í flugvirkikönnunum en a.m.k. 2 ungernir flugu þar yfir 2022-2023 skv. GPS gögnunum frá Náttúrufræðistofnun.”

Frá því að mælingar hófust árið 2019 hafa 39 fuglar verið merktir. Árið 2023 var áætlað að hafarnarstofninn taldi 90 virk hafarnarpör þannig að gagnasafnið er gríðarlega yfirgripsmikið. Í því mengi sem svarar til 40 km radíus frá framkvæmdarsvæði hafa safnast 979.842 staðsetningarpunktar frá 37 fuglum.

Eingöngu tveir punktar hafa mælst inna marka vindorkugarðsins á 5 árum. Það kemur ekki á óvart ef eðli arnarins og lega landsins er tekin til greina.

Að því sögðu eru líkur á að örn verð fyrir skaða mjög lágar eða einn fugl á 100 ára fresti enda hafa ernir náttúrulega forðun og eru ekki líklegir til að sækja svæðið. Þeir fuglar sem eru líklegastir til að fara upp á fjall eru ráfandi ungfuglar sem ekki hafa hafið varp og fráfall slíks einstaklings myndi síður hafa áhrif á stofninn.

Það er síendurtekið samneyti við vindmyllur sem fellir erni, ekki tilviljunarkennd heimsókn.

Sú umferð sem liggur nærri Garpsdalsfjalli er eðlileg. Enda kjósa ernir dali þegar þeir ferðast yfir til Steingrimsfjarðar sem kemur klárlega í ljós þegar hitamynd af umferð er skoðuð. Staðsetning vindorkugarðsins uppi á fjalli dregur þannig úr hættu á árekstri.

Vindorkugarður í Garpsdal mun hafa hverfandi áhrif á stofn hafarna og það eru engin vísindaleg rök sem gefa til kynna að um óvissu sé að ræða.

Þegar ofnagreint er tekið til greina þá eru niðurstöður 5. áfanga hartnær þær sömu og 4. áfanga hvað vindorkugarð í Garpsdal varðar. Þar af leiðir að engin vísindaleg rök eru fyrir því að breyta flokkun vindorkugarðs í Garpsdal úr nýtingu í bið.

Viðaukar:

- Náttúrustofa Vestfjarða - Árekstraráhættumat fyrir hafarni við vindorkugarð í Garpsdal.
- John Murphy - White-tailed Eagle movements in the Garpsdalur Region of North-west Iceland
- Alan Fielding - Expert opinion on the likely impact of a proposed wind farm at Garpsdalur on White-tailed Eagles

EM Orka áskilur sér allan rétt til þess að setja fram frekari gögn, upplýsingar og skýringar á síðari stigum.

Ríkarður Örn Ragnarsson
Verkefnastjóri Vindorkugarðs í Garpsdal.

Árekstrarhættumat fyrir haferni við vindorkugarð í Garpsdal

Þetta minnisblað er að beiðni EM Orku þar sem Náttúrustofa Vestfjarða hefur verið beðin um að nota hreyfigögn til að kanna hættu á árekstri haförnsins (*Haliaeetus albicilla*) við vindmyllur í fyrirhuguðum vindorkugarði í Garpsdal.

Eftirfarandi skýrsla byggir á ferðagögnum sem söfnuð voru á tímabilinu september 2021 til ágúst 2024 úr GPS mælitækjum sem Kristinn Hauki Skarphéðinsson og samstarfsfólk hans við Náttúrufraeðistofnun komu fyrir á 39 haförnum. Einstaklingarnir sem merktir eru eru hluti af stofn 180 einstaklinga sem nýta búsvæði milli Faxaflóa og Húnaflóa. Mælingarnar veita upplýsingar um tíma, staðsetningu, hraða, stefnu, loftþrýsting, hitastig, fjölda gervihnattatenginga, vegalengd frá síðustu mælingu og hæð sem skráð er við hverja stefnubreytingu sem GPS greinir.

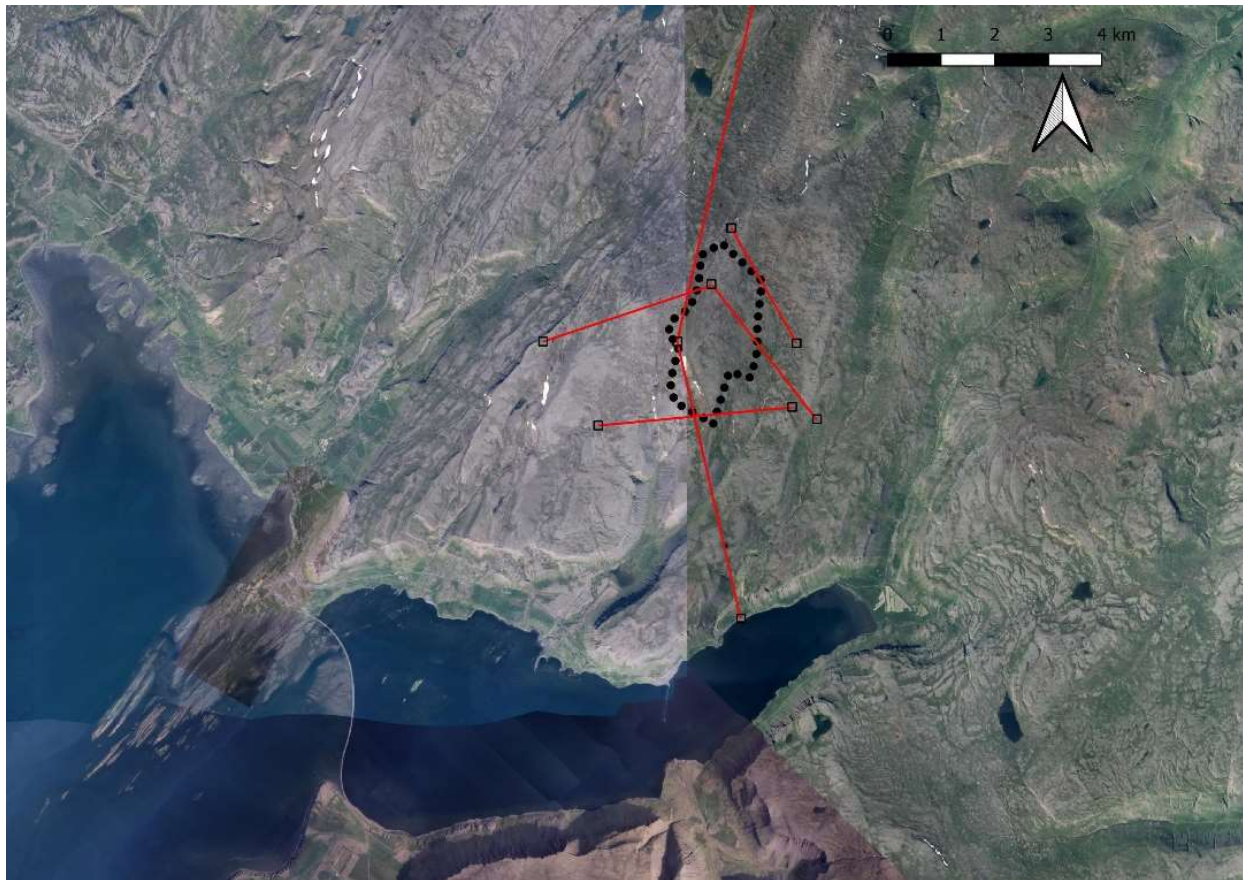
Niðurstöður benda til þess að á gagnasöfnunartímabilinu hafi fjórir ernir flogið yfir svæðið í fjögur aðskilin skipti. Af fjórum flugferðum yfir svæðið var árekstrarhættan lítil til miðlungs, þar sem heildarhættan að haförn yrði fyrir vindmyllu árekstri var 0,01 örn á ári. Öll flugin um svæðið hafa líklega verið innan hæðar vindmyllublaðs og voru farin utan vetrarmánaða. Af 39 merktum fuglum voru 177787,9 km flug metnir, þar af 4,47 km innan svæðisins.

Aðferðir

Til að búa til höggáhættumat voru gögn um flughæð, stefnu og hraða tekin úr gagnapunktum næst staðnum og sett í Band Collision Risk Model. Um er að ræða 2 hluta útreikning sem er hannaður til að mæla hættuna á áhrifum á fugla sem fljúga í gegnum fyrirhugað vindorkuver. Handvirkar athuganir með sjónarhornskönnunum eða sniðtalningum eru staðlaðar aðferðir við gagnaöflun í þessu líkani en einnig er hægt er framkvæma þennan útreikning með GPS gögnum. Nafn, auðkenni merkisins og greiningartíma má sjá í töflu eitt, flugleiðirnar má sjá á mynd 1.

Tafla 1: Gagnapunktur notaðir við áflugsáhættumat á merktra erna sem hafa flogið yfir fyrirhugaðan vindorkugarð.

Time	Individual	Tag ID
14/06/2023 15:00	Gleri	7311
08/05/2024 14:30	Krskur	7111
30/06/2024 11:01	Ernir	3976
16/07/2024 19:05	Garpur	7308



Mynd 1: Flug hafarnanna 4. yfir svæðið.

Fyrsta skrefið felur í sér útreikning á áreksturshættu fyrir einstakar ferðir um svæðið, en þar er tekið er tillit til upplýsinga um fyrirhugaðan vindgarð, stærð og hraða fuglsins og hvort hann hafi verið að blakta eða svífa (hvort fuglinn er að blakta eða ekki hefur áhrif á þversnið fuglsins í gegnum snúningssvæðið, sem hefur einnig áhrif á líkur hans á að verða fyrir höggi). Einnig er innifalinn tímalengd vöktunar á svæðinu sem Náttúrustofa Norðausturlands stóð fyrir á árunum 2019 til 2021 (Hálfván H Helgason, 2023). Lengd vöktunartíma þeirra og lengd flug merktar arna yfir svæðinu var sameinuð og notuð sem breyta fyrir "lengd vöktunar á staðnum" í formúlunni.

Gögn um vindátt og hraða voru fengin frá Veðurstofustöð á Gillastaðamelum og sameinuð flugleiðum arnanna til að finna aðflugsstefnu að vindmyllunum. Vegna þess að við getum ekki sagt til um hvort fuglinn var að blakta eða svífa reiknum við bæði gildin hér. Formúlan fyrir útreikning á hversu margir ernir eru líklegir til að fluga yfir svæðið á hverju ári er eins og hér segir:

$$N_{\text{transects}} = (T_{\text{obs}} / T_{\text{mon}} * A_{\text{vis}}) * P_{\text{risk}} * A_{\text{risk}} * T_{\text{active}} * (V_r / V_w) / T_{\text{transit}}$$

Seinni hluti útreikningsins tekur niðurstöðu áreksturshættu fyrir hvert flug til að gera mat á því hversu margir fuglar gætu orðið fyrir á ári. Það tekur tillit til þess hversu margir fuglar eru líklegir til að fljúga í gegnum snúningssvæðið á hverju ári og líkurnar á því að fugli takist ekki að forðast hættu. Formúlan fyrir heildarhættu á árekstrum fugla er sýnd hér að neðan:

$$\text{Number of birds colliding per annum} = \text{number flying through rotor area} * \text{probability of bird being hit by rotor}$$

Fjöldi fugla sem flugu í gegnum snúningssvæðið var reiknaður með upplýsingum frá GPS mælingargögnum. Til að ákvarða fjölda ferða um svæðið var lengd vöktunar borin saman við þann tíma sem fuglarnir dvöldu á staðnum, auk þess sem búast mætti við að fuglarnir væru til staðar. Hlutfall flugferða innan lóðrétta hættusvæðisins og flughraði var einnig tekið til greina við þennan útreikning.

Líkurnar á því að fugl verði fyrir snúningsblaði eru reiknaðar út í lokahluta greiningarinnar. Þessar líkur eru byggðar á May R (2011) þar sem lagt er til, byggt á gervihnattafjarmælingum, að 95% erna muni forðast hættusvæðið. Formúlan fyrir þennan útreikning er sem hér segir:

$$\text{Avoidance Rate} = 1 - \text{actual collisions} / (\text{number of birds flying through the rotor swept zone} \times \text{hit probability})$$

Niðurstöður

GPS mælingar benda til þess að 4 einstaklingar hafi flogið yfir svæðið í fjögur aðskilin skipti (tafla 2). Niðurstöður útreiknings á árekstrarlíkum benda til þess að þessir einstaklingar hafi verið með áreksturshættu á bilinu 0,066 til 0,203 á svifi og áreksturshættu á bilinu 0,07-0,203 á flakki, sem bendir til þess að í þessum flugferðum hafi líkur á árekstri verið 6-20%.

Tafla 2: Árekstrarhætta leiðir til tilvika þar sem ernir flugu um svæðið. Þessi gildi gefa til kynna áhættuna fyrir einstaklinga í skráðu flugi.

Individual	Collision risk while gliding	Collision risk while flapping
Gleri	0.145	0.138
Krskur	0.203	0.203
Ernir	0.066	0.07
Garpur	0.116	0.117

Niðurstöður áhættumats benda til þess að líklegt sé að 0,01 erni verði fyrir höggi á hverju ári (tafla 3). Hins vegar verður að hafa í huga að útreikningar á áhrifaáhættu (árekstrum á ári) sem settir eru fram hér að ofan taka ekki tillit til gagna frá ómerktum einstaklingum (141 af 180) og að gögn frá aðeins 4 af 39 merktum einstaklingum eru með í þessari greiningu.

Tafla 3: Niðurstöður áhættumats á áhrifum

	Eagles gliding	Eagles flapping
Impact Risk (Collisions per annum)	0.0100445771	0.0100066731

Umræða

Áhættumat er töl sem hægt er að nota til að lýsa áhættunni sem stafar af fuglum á tilteknum stað og er búsvæðanotkun og hegðun fuglanna á lífsleiðinni ekki hluti af útreikningnum. Það er krefjandi að spá fyrir um hættuna fyrir ómerktum fugla, þó þeir deili búsvæðum er ekki vitað hvort allir eða einhverjir séu nokkurn tíma á svæðinu. Hins vegar eru 21,6% stofnsins merktir og 10,2% merktu stofnsins flugu yfir svæðið á tímabilinu september 2021 til ágúst 2024. Þ.a.l., gætu mögulega 18.46 merktir og ómerktir ernir hugsanlega flogið yfir svæðið á 3 ára tímabili, eða 6 flug á ári.



Farleiðir erna eru sýnd á mynd 2. Þar sést að fuglarnir eru greinilega að nota dalina sitt hvoru megin við athafnarsvæðið til að ferðast á milli Breiðafjarðar og Steingrímsfjarðar. Tilvikin þar sem fuglarnir koma inn á svæðið gætu mögulega verið vegna þess að þeir skipta frá einni flugleið til annarrar, kannski eftir vindátt.

Í fyrsta stigi útreikningsins var reiknuð árekstrarhætta fyrir svæðið. Þetta lýsti aðeins skráðum tilvikum þar sem ernirnir flugu um svæðið. Seinni hluti útreikningsins tekur þessa tölu og reiknar þær upp í áætlaða umferð yfir heilt ár af skráðum athugunum. Til að skilgreina áætlaða umferð þarf að mæla tímann sem merktir ernir fluga í gegnum svæðið og þann tíma sem athugendur hafa eytt á staðnum í leit að fuglum. Þetta þýðir að þrátt fyrir að fylgst var með flugleið 39 arna samfelt í nokkur ár, var aðeins hægt að nota tímann sem ernirnir eyddu á staðnum í þetta áhættumat.

Eins og lýst er í grein frá May 2011, er geta hafarna til að forðast árekstri háð fjölda þátta, þar á meðal snúningshraða vindmillanna. May (2011) bendir á að jafnvel þegar vindmillur eru kyrrstæðar ná höggglíkurnar aldrei núlli, heldur haldast undir 20% með snúningshraða yfir 1 snúning á 3. sekúndu fresti (May R, 2011).

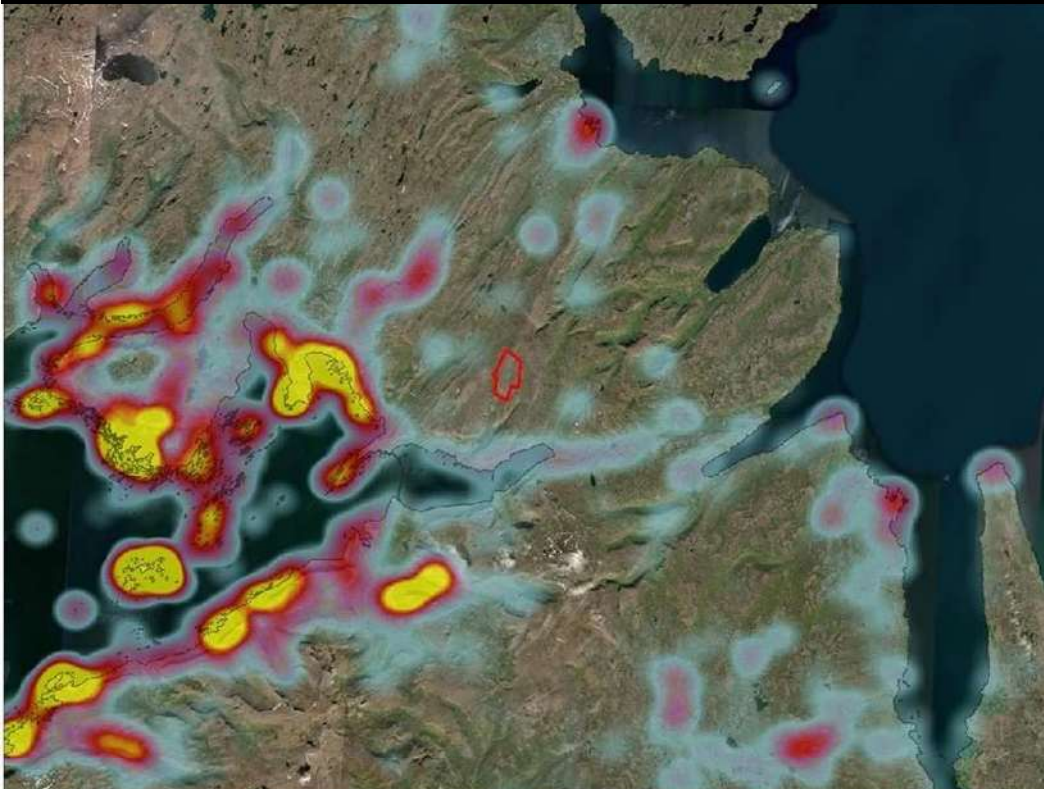
Niðurstöður áhættumats sýna að líkurnar á því að fugl komist inn á svæðið og verði síðan fyrir vindmyllublaði eru tiltölulega litlar. Niðurstöður eins og 0,01 fugl á ári eru þó ekki samlagðar, þ.e. að það má ekki endilega búast við því að fugl yrði drepinn á 100 ára fresti ($0,01 \cdot 100 = 1$).

Niðurstöður benda hins vegar til þess að þetta sé ekki svæði sem fuglarnir nota oft, eins og sjá má á mynd 2.

Hitakortið byggir á sömu hreyfigögnum og hráu GPS-gögnin sem sýnd eru á mynd 2, en með hitakorti er betur hægt að sjá þau búsvæði sem oftast eru notuð. Eins og sést á myndinni eru eyjar og strandsvæði Breiðafjarðar oftast nýtt, ásamt nokkrum dölum.



Fjarlægt að beiðni Náttúrufraeðistofnunar Íslands



Mynd 2: Flugleiðir merkta erna innan 40 km rafiuss fyrir ofan, hitakort að neðan sýnir sömu gögn.

Heimildir

Hálfván H Helgason, H. W. (2023). *Fuglalíf á Hrauni við Garpsdal og nærsvæðum*. Náttúrustofa Austurlands.

May R, N. T. (2011). *Collision risk in white-tailed eagles: Modelling kernel-based collision risk using satellite telemetry data in Smola wind-power plant*. Trondheim: NINA.

f.h. Náttúrustofu Vestfjarða

Christopher Long, M.Sc.

White-tailed Eagle movements in the Garpsdalur Region of North-west Iceland

John N Murphy

Lead Ornithologist with the EMpower, Garpsdalur Wind Farm Project & Senior Ornithologist & Manager of Irish Ornithological Survey Group (IOSG).

In a further information request, with regard to documented movements of White-tailed Eagles *Haliaeetus albicilla* in the Gilsfjörður, and the surrounding region for the proposed Garpsdalur Wind Farm site location.

In order to satisfy the two main concerns as outlined in the further information request;

1. The air traffic of GPS tracked White-tailed eagles *Haliaeetus albicilla* and movements close to and over the proposed Garpsdalur Wind Farm (four individual birds on the site).
2. Dense eagle nest sites nearby and considerable eagle traffic along the edges of Garpsdalsfjall Mountain.

The presence of a poorly sited wind farm can raise concerns for wildlife, including birds of prey. This was one of the issues considered in advance of positioning this project in the Garpsdalsfjall Mountain range. As a highly experienced bird surveyor of hundreds of wind farm projects and with over 45 years of ornithological studies carried out since the mid 1970's, I was requested to advise and look at setting up bird studies in this location for the proposed Wind Farm project by EM Orka.

At the outset and in the original setup of these surveys (using the Scottish Natural Heritage 2017 methodology), In order to get a better picture and understanding of bird activities, I proposed that we not only cover the avifauna on the original site, but we also considered and did our best to understand bird community activity throughout this region. This included the White-tailed Eagle *Haliaeetus albicilla* and other common bird species found in this localised area of northwest Iceland.

Areas covered to gather this additional information included Gilsfjörður (Vestfjarðavegur, Tröllatunguvegur, Djúpvegur to Hólmavík) Innstrandavegur road to the north and Strandabyggð (where the Black Guillies nest) and Króksfjarðarnes.

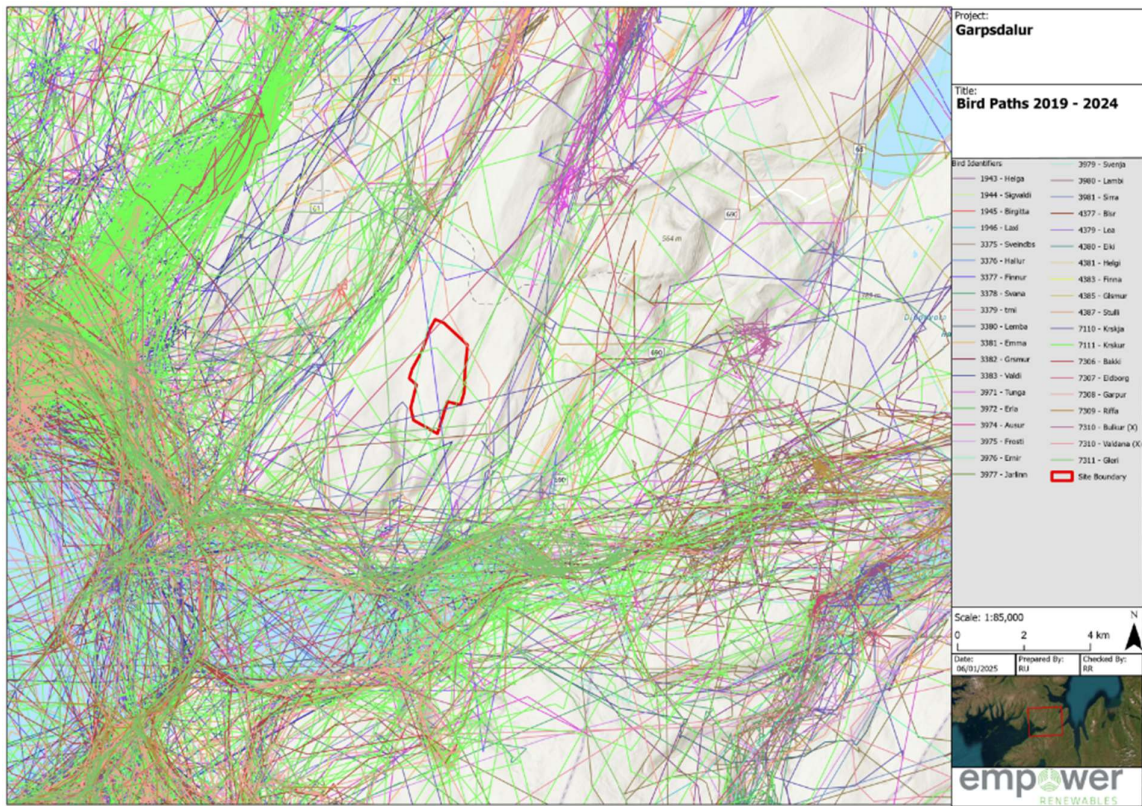
In an attempt to answer the above complex request on the movements of WTEs in this region, the following is my interpretation of why birds are using the current recorded flight paths as seen in the GPS location data;

Icelandic White-tailed Eagles *Haliaeetus albicilla* live mainly in the lowlands and mainly around shorelines and fjords in the north west of the country. Here there are up to 90 pairs nesting on suitable low lying island within these fjords, where the majority of their food source is more readily available throughout the year. In these fjords and adjacent fields and valleys, birds nest and feed, and fly around hunting suitable food prey. Flight paths depicted in the monitored satellite tracked birds between the years of 2019 to 2024, are mainly of immature birds that were tagged on the nest as pulli. The following information is my assessment of what the flight paths of the satellite tagged eagles, are potentially doing once they dispersed from the nest sites. Some of these flight paths are locations where adults also hunt their prey, to provide food for their juveniles, whether they are still on the nest, or sitting around in locations on lowland fields and outcrops awaiting food drops. We studied the flight paths of 39 individually tagged birds that traversed this region within a 40km radius and hundreds of kilometres of movements surrounding the proposed Wind Farm project on the plateau at Garpsdalsfjall Mountain.

Similar studies of flight paths of immature White-tailed Eagles *Haliaeetus albicilla* have taken place in Finland (<https://pmc.ncbi.nlm.nih.gov/articles/PMC5055479/>). Here they also found that satellite tagged juveniles tend to stick to coastal regions where natural food sources are readily available throughout the year, even in times of heavy snowfall and freezing conditions. This is a very similar picture in north-west Iceland where in

recent times global weather patterns have changed and freezing seas are less likely nowadays than they were in past times.

In summer, adult birds would take fish, young juvenile geese and other common wildfowl and any dead seal or marine cetacean carcasses washed up along the shore. During times of migration periods when Pink-footed Geese *Anser brachyrhynchus* or locally breeding Greylag Geese *Anser anser* gather in communal family flocks in traditional fields throughout the valleys, leading off these fjords, making it suitable for White-tailed Eagles *Haliaeetus albicilla* to pick off geese, especially visiting Barnacle Geese *Branta leucopsis* heading from breeding grounds in Greenland to overwintering grounds in Britain & Ireland. White-tailed Eagles *Haliaeetus albicilla* can also pick crustaceans and mollusc along shorelines in times of low bird or mammal presence, another reason why birds stick mainly to coastal locations in summer, but especially in winter where ice free shores provide feeding for prey species and eagles.



From the flight paths gathered over the 5 year period outlined, flight paths do depict immature and recently fledged eagles dispersing in many directions in this region of north-west Iceland, as would be expected. This is the case wherever this species is found in parts of Europe or Iceland. The flight paths show birds utilising valleys to fly through, to reach other fjords where food is the main target and meeting other offspring of nesting eagles to pair off with in future years. Some birds do explore bodies of water en-route to these other fjords and they soon find that many of the isolated locations at the tops of mountains and plateaus, do not provide enough food or shelter to sustain their full time existence, especially in winter months, where I'm sure a certain percentage of birds must perish naturally.

Likewise in late summer, when young eagles frequenting some of the lakes in upland regions of this mountain range after fledging, natural food source like wildfowl and fish can often be lower in quantities, to that of lowland habitats surrounding the plateaus and mountain tops. Rivers flowing through these mountains to the north and south of the proposed wind farm hold Brown Trout *Salmo trutta* and Atlantic Salmon *Salmo salar* or

Salmon Par, which White-tailed Eagles *Haliaeetus albicilla* may occasionally catch while travelling these systems. Most of the prey and small fish are probably eaten by Goosanders and other fish loving ducks, or small hatching ducklings by foraging Lesser Black-backed Gulls *Larus fuscus* or Grey Herons *Andrea cinerea*. The higher lakes would support native fish such as Arctic Char *Salvelinus alpinus* which are a deep water species and probably eaten by Red-throated Diver *Gavia stellata* Great Northern Divers *Gavia immer* and grebes, which breed in such isolated lakes. Successful hunting for eagles may be much more difficult at these altitudes, but the lower down plains provide a greater supply and mix of food source. Due to this and as would be expected, there is less eagle activity recorded in the highlands to that of the lowlands.

Icelandic mountain tops and lakes are bereft of trees unlike many areas of Fenno-Scandinavia and Britain or Ireland. Lack of tree line around shorelines of these Fjords and lakeside, are more readily available in northern and Western Europe. This must limit nesting and hunting options for sea eagles in north-west Iceland at these higher altitudes. Very few of the lakes have islands large enough to sustain breeding pairs of eagles, another reason why we see much more flight path activity in the seashore fjords and bays.

White-tailed Eagles *Haliaeetus albicilla* don't like to fly in fog or days when there are high winds or poor visibility. Large eagles like this tend to sit tight on the ground during these conditions as they cannot manoeuvre very well. White-tailed Eagles *Haliaeetus albicilla* like the majority of this family have extremely good eyesight with 20/20 vision for catching prey. With such vision they can easily identify and allow them to avoid moving turbine blades with flashing beckons to assist in birds spotting them in poor light conditions, even young immature birds. I oversee a large Wind Farm site in the west of Ireland with over 60 turbines, where post construction monitoring is carried out to see do White-Tailed Eagles *Haliaeetus albicilla* collide with large turbines. On this site we have a pair of White-tailed Eagles *Haliaeetus albicilla* nesting on the western fringes of the wind farm that in a nest, on the island, within a small lake (approximately 3km away). The young birds that fledge this nest regularly fly in and out of the wind farm. They often sit on rocks under the turbines and completely and successfully avoid the blades. There was never a collision on this site of eagles in a landscape similar to parts of north-west Iceland, but with greater mature tree line which they fly between. The nearest White-tailed Eagle *Haliaeetus albicilla* nest site to our proposed wind farm is approximately 7.6km away. This is sufficient distance as to not disturb any breeding eagles in Gilsfjörður and beyond.

As outlined in the beginning of this report, only four individuals came within or close to the site boundary in two seasons of avifauna monitoring at the proposed Garspdalur Wind Farm Project Phase 1. This is a tiny per cent of the overall population breeding on the island of Iceland and wind turbines on the top of this mountain should not have any adverse effect on the overall White-tailed Eagle *Haliaeetus albicilla* population, whether breeding or foraging for food. My conclusion is that the site at Garspdalur would be the best location in this region to construct such a green Energy project.

Expert opinion on the likely impact of a proposed wind farm at Garpsdalur on White-tailed Eagles

Alan Fielding BSc (Hons), MSc, PhD, FHEA, FLS

My Conclusion

The development of Garpsdalur windfarm, near to the population of breeding White-tailed Eagles in the Breiðafjörður's fjord, would not have a measurable impact on breeding and dispersing individuals from the local population.

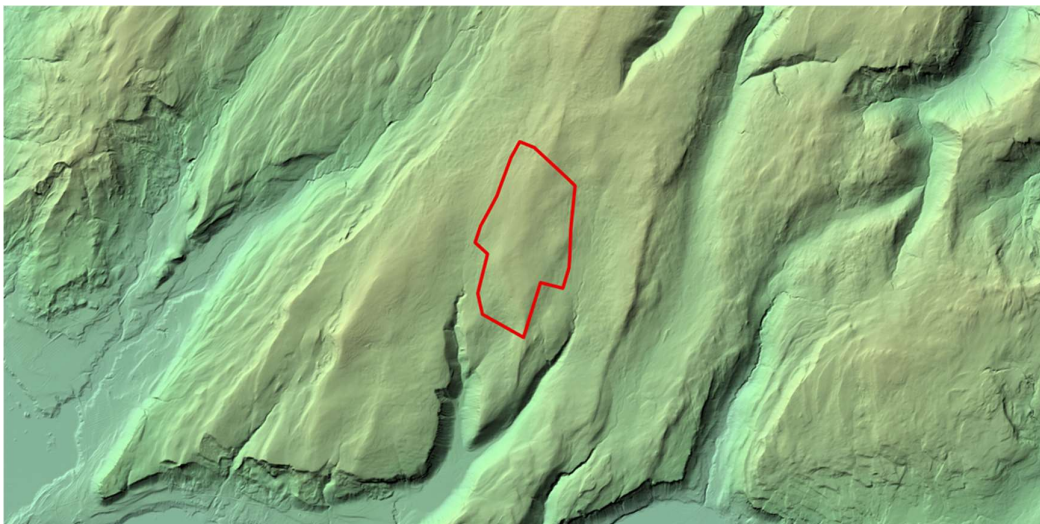
Evidence supporting my conclusion

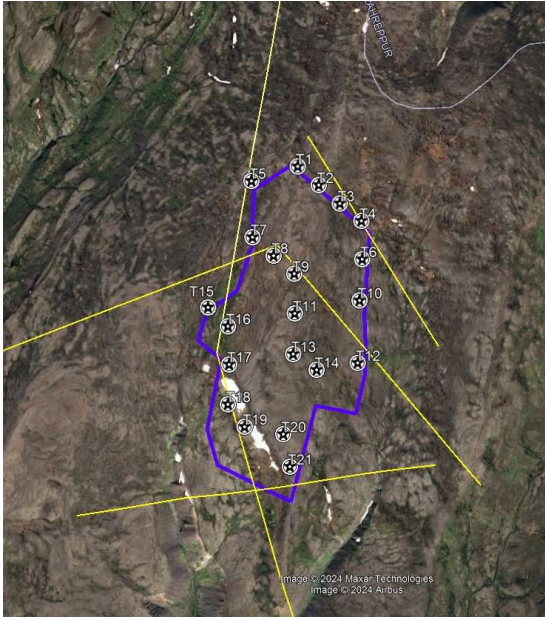
I have extensive experience analysing eagle satellite tracking data. I am the curator for more than 12 million records from ~350 Golden Eagles and White-tailed Eagles in Scotland. I have published extensively on what satellite tracking tells us about how Golden Eagles interact with turbines and their general biology. I also have considerable experience of modelling White-tailed Eagle populations for both wind farm impact assessments and reintroduction programmes.

We developed a very successful model (Golden Eagle Topographic model, GET), using satellite tracking data. The GET model predicts how Golden Eagles use topography (Fielding *et al* 2020). This model is now used to guide both wind farm and tree planting schemes in Scotland and is part of the NatureScot guidance to developers and foresters. The same techniques could be applied to White-tailed Eagles and the data collected in the region around the Breiðafjörður's fjord provides an ideal opportunity to develop a similar model which could be useful for guiding potential development sites and helping to avoid placing turbines in inappropriate locations.

It is apparent from the GET model that Golden Eagles use topography to move across the landscape and turbines even a few hundred meters from the preferred topography are unlikely to pose a risk to Golden Eagles. Visual inspection of the White-tailed Eagle flight lines in the region around the Breiðafjörður's fjord suggest that White-tailed Eagles also use topography to move around the landscape but their preferred routes are almost the opposite of those used by Golden Eagles.

There are significant White-tailed Eagle movements close to Garpsdalur mountain but the fact that the main routes are through valleys, and Garpsdalur windfarm is on a mountain/ridge, immediately reduces the potential for a collision.





There are only four flight lines passing over Garpsdalur windfarm boundary and there is little certainty that at least two passed through the wind farm given the time and distance differences between the start and end points of the flights.

Even when a White-tailed Eagle flies through a wind farm a collision is not inevitable. A particular set of circumstances are required before a collision occurs and, in Scotland, current guidance suggests that only 5 out of every 100 flights through a turbine's swept radius (a much smaller definition than the wind farm boundary) would result in a collision.

Heatmaps, based on extensive satellite tracking of dispersing White-tailed Eagles were provided to me (see Appendix – Heatmaps 2020 to 2024). It is

only possible to draw broad conclusions from the heatmaps as I have no information on the number of birds, their ages, whether they had not yet left their natal range or were they in a dispersal phase? Also, it matters if they are moving or roosting at the time of the record and, importantly, are they during daylight (night time roosting records produce clusters of records)? Nonetheless, three broad conclusions can be drawn from the heatmaps.

1. The tag records of these non-breeding birds are very much associated with Breiðafjörður's fjord and there appears to be little activity, by these tracked birds, on the east coast.
2. There are many areas, including the site of the wind farm, which are not used.
3. It is reasonable to assume that the site of the wind farm, and similar topography, are not important areas for non-breeding White-Tailed eagles.

Adult White-tailed Eagles generally remain in their territories during the nonbreeding season, whereas immature birds can roam widely. Despite roaming widely the type of terrain between the valleys does not appear to be attractive, as evidenced by the very small number of tracks over a long period from many tracked individuals.

The extremely low level of dispersing White-tailed Eagle flight activity around Garpsdalur windfarm results in an estimated annual number of collisions of 0.01 or one death every 100 years. Such a small additional level of mortality cannot have any impact on the viability of the local White-tailed Eagle population. The already tiny population-level impact is reduced even further if the collision victim is a dispersing young bird rather than a member of a breeding pair. This is evident from the elasticity of the dispersing bird survival rate in population models. The impact of additional deaths would be more significant if it was a member of a potentially breeding pair (although at a rate of one death every 100 years even that effect would still be undetectable).

The NatureScot guidance for avoiding disturbance to White-tailed Eagles is from Goodship and Furnace (2022)¹. *"In the UK, white-tailed eagle has the potential to be disturbed on breeding grounds as well as at communal roosting areas and foraging grounds during the nonbreeding season; this species is most likely to be disturbed pre- and during egg laying early in the breeding season.*

¹ Goodship, N.M. and Furness, R.W. 2022. *Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species*. NatureScot Research Report 1283, Edinburgh, Scotland.

*Depending on the level of habituation to disturbance, a **buffer zone of 500-1000m is suggested to protect nesting white-tailed eagles** and a buffer zone of 250- 500m is suggested to protect roosting and foraging birds during the nonbreeding season from pedestrian disturbance. Buffer zones at the lower end of these ranges may be sufficient to protect individuals that have some habituation to human presence."*

The closest nest sites in the Breiðafjörður's fjord are at least 8 km from the proposed wind farm. This distance is eight times larger than the largest buffer distance recommended by Goodship and Furnace (2022) in Scotland. Fulmar colonies in the Western Isles of Scotland appear to be unaffected by predation by breeding White-tailed Eagles if the nest is >5 km from the colony (Reid, *pers comm*).

Therefore, there is no evidence that a Garpsdalur wind farm would have any impact on the breeding pairs in the Breiðafjörður's fjord

Brief summary of experience

Academic history and professional recognition

- University of Liverpool: BSc (Hons) and PhD.
- University of York; MSc Biological Computation.
- Leverhulme Personal Research Fellow 2000-2001
- University Senior Learning and Teaching Fellow 2001-2010 (Retired)
- Fellow of the Linnean Society of London
- Fellow of the Higher Education Academy
- Member of Scottish Natural Heritage Scientific Advisory Committee Experts Panel (2012-2021)
- Expert advisor to Irish Golden Eagle Trust with respect to the four raptor reintroductions: golden eagle; white-tailed eagle, red kite and osprey
- Expert advisor to a study of the impacts of wind farms on hen harriers in Ireland (2013-2017).
- South of Scotland Golden Eagle Project - member of Scientific Advisory Panel (2018-current)
- Member of the Forests and raptors joint working group (2018-current)
- Advisor to NatureScot on updating golden eagles and wind farms advice (current)

Books

1. Fielding, A. H. 1984. *Computing for Biologists*. 190pp, Addison-Wesley, Wokingham.
2. Fielding, A. H. 1999. (editor) *Ecological Applications of Machine Learning Methods*. 261pp. Kluwer Academic, Boston, MA.
3. Fielding, A. H. and Haworth, P. F. 1999. *Upland Habitats*. 141pp. Routledge, London.
4. Thompson, D. B. A., Redpath, S., Fielding, A. H., Marquiss, M. and Galbraith, C. A. (eds). 2003. *Birds of prey in a changing environment*. 550 pp, The Stationery Office, Edinburgh.
5. Fielding, A. H. 2006. *Cluster and classification techniques in the BioSciences*. Cambridge University Press, Cambridge.

Selected chapters in books

1. Bibby, C., Marsden, S. and Fielding, A. H. 1999. Bird-habitat studies. pp 99-114 in C. Bibby, M. Jones and S. Marsden (eds) *Expedition Field Techniques: Bird Surveys*. Expedition Advisory Centre, Royal Geographical Society, London.
2. Fielding, A. H. 1999. How should accuracy be measured? pp. 209-223 in A. Fielding (ed) *Ecological Applications of Machine Learning Methods*. Kluwer Academic, Boston, MA.
3. Fielding, A. H. 1999. A review of machine learning methods. pp 1-37 in A. Fielding (ed) *Ecological Applications of Machine Learning Methods*. Kluwer Academic, Boston, MA.
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5. Fielding, A.H., Whitfield, D. P., McLeod, D. R. A., McGrady, M. and Haworth, P. F. 2003. Modelling the impact of land use changes on golden eagles *Aquila chrysaetos*. pp 323 - 340 in Thompson, D. B. A., Redpath, S., Fielding, A. H., Marquiss, M. and Galbraith, C. A. (eds). *Birds of prey in a changing environment*. The Stationery Office, Edinburgh.
6. Fielding, A. H., Morgan, D., Haworth, P. F., Whitfield, D. P. and Thompson, D. B. A. 2003. The impact of golden eagles on other raptors. pp 221-244 in Thompson, D. B. A., Redpath, S., Fielding, A. H., Marquiss, M. and Galbraith, C. A. (eds). *Birds of prey in a changing environment*. The Stationery Office, Edinburgh.

7. Watson, J, Fielding, A.H., Whitfield, D.P., Broad, R.A., Haworth, P., Nellist, K., Crane, K. & Macdonald, E.J. 2003. Golden eagle breeding performance in relation to climate in western Scotland during the period 1981-2000. pp 149-161 in: Thompson, D.B.A., Redpath, S., Fielding, A.H., Marquiss, M. & Galbraith, C.A. (eds.). *Birds of Prey in a Changing Environment*. The Stationery Office, Edinburgh, UK.
8. Benn, S., Fielding, A.H. & Whitfield, D.P. 2024. Golden Eagles in Scotland. pp 265-281 in: Rodriguez, J.B. & Ellis, D.H. (eds) *The Golden Eagle Around the World A Monograph on a Holarctic Raptor*. Hancock House Publishers, Surry, BC, Canada

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1. Whitfield, D. P., Fielding, A. H., McLeod, D. R. A. and Haworth, P. F. 2006. *A conservation framework for the golden eagle: implications for the conservation and management of golden eagles in Scotland*. SNH report number 193.
2. Whitfield, D. P., Fielding, A. H., McLeod, D. R. A., Haworth, P. F. and Watson, J. 2006. A conservation framework for the golden eagle in Scotland: refining condition targets and assessment of constraint influences. *Biological Conservation*, 130(4): 465-480.
3. Fielding, A., Haworth, P., Whitfield, P., McLeod, D. & Riley, H. 2011. *A Conservation Framework for Hen Harriers in the United Kingdom*. JNCC Report 441. Joint Nature Conservation Committee, Peterborough
4. Grainger, M., Fielding, A & Whittingham, M. 2015. Desk based review of the methods used to assess the effects of wind farms on different bird species. SWBSG Commissioned report number 1501. 29pp.
5. Dunn, J.C., Zwart, M.C., Kerr, S., Fielding, A.H. & Whittingham, M.J. 2015. Desk based evaluation of wind farms and habitat management in Scotland. SWBSG Commissioned report number 1503. 52 pp.
6. Roos, S., Dobson, A., Noble, D., Haworth, P., Fielding, A., Carrington-Cotton, A., Etheridge, B. & Wernham, C. 2015. Raptors in Scotland - a methodology for developing trends and indicators. Scottish Natural Heritage Commissioned Report No. 542
7. Whitfield, D.P. and Fielding, A.H. 2017. Analyses of the fates of satellite tracked golden eagles in Scotland. Scottish Natural Heritage Commissioned Report No. 982. This report was instrumental in bringing about a novel law, the Wildlife Management and Muirburn (Scotland) Act 2024 (<https://www.legislation.gov.uk/asp/2024/4>).

Recent peer-reviewed scientific papers

1. Fielding, A. H., Haworth, P. F., Anderson, D., Benn, S., Dennis, R., Weston, E. and Whitfield, D. P. 2020. A simple topographical model to predict Golden Eagle *Aquila chrysaetos* space use during dispersal. *Ibis* 162(2), 400-415.
2. Fielding, A.H., Anderson, D., Benn, S., Dennis, R., Geary, M., Weston, E. and Whitfield, D. P. 2021. Non-territorial GPS-tagged golden eagles *Aquila chrysaetos* at two Scottish wind farms: macro-avoidance influenced by preferred habitat distribution, wind speed and blade motion status. *PLoS One*.
3. Fielding, A. H., Anderson, D., Benn, S., Dennis, R., Geary, M., Weston, E. and Whitfield, D. P. 2022. Responses of dispersing GPS-tagged Golden Eagles (*Aquila chrysaetos*) to multiple wind farms across Scotland. *Ibis* 164(1), 102-117.
4. Whitfield D. P., Fielding, A. H., Anderson, D., Benn, S., Dennis, R., Grant, J. & Weston, E. D. 2022. Age of First Territory Settlement of Golden Eagles *Aquila chrysaetos* in a Variable Competitive Landscape. *Frontiers in Ecology and Evolution*, 10, DOI=10.3389/fevo.2022.743598.

5. Fielding, A. H., Anderson, D., Benn, S., Reid, R., Tingay, R., Weston, E. D. and Whitfield, D. P. 2023. Substantial Variation in Prospecting Behaviour of Young Golden Eagles *Aquila chrysaetos* Defies Expectations from Potential Predictors. *Diversity* 15, no. 4: 506. <https://doi.org/10.3390/d15040506>
6. Fielding, A.H., Anderson, D., Benn, S. Taylor, J., Tingay, R., Weston, E.D. and Whitfield, D.P. 2023. Responses of GPS-Tagged Territorial Golden Eagles *Aquila chrysaetos* to Wind Turbines in Scotland. *Diversity*, 15, 917. <https://doi.org/10.3390/d15080917>
7. Whitfield, D. P., Fielding, A. H., Anderson, D., Benn, S., Reid, R., Tingay, R. and Weston, E. D. 2024. Sex difference in natal dispersal distances of Golden Eagles *Aquila chrysaetos* in Scotland. *Ibis*, 166,146-155. <https://doi.org/10.1111/ibi.13225>
8. Fielding, A. H., Anderson, D., Benn, S., Taylor, J., Tingay, R., Weston, E. D. and Whitfield, D. P. 2024. Approach Distances of Scottish Golden Eagles *Aquila chrysaetos* to Wind Turbines according to Blade Motion Status, Wind Speed, and Preferred Habitat. *Diversity*, 16(1), 71; <https://doi.org/10.3390/d16010071>
9. Whitfield, D. Philip, Alan H. Fielding, David Anderson, Stuart Benn, Robin Reid, Ruth Tingay, and Ewan D. Weston. 2024. Seasonal Variation in First Territory Settlement of Dispersing Golden Eagles: An Innate Behaviour? *Diversity* 16, no. 2: 82. <https://doi.org/10.3390/d16020082>
10. Fielding, A.H.; Anderson, D.; Barlow, C.; Benn, S.; Reid, R.; Tingay, R.; Weston, E.D.; Whitfield, D.P. 2024. Golden Eagle Populations, Movements, and Landscape Barriers: Insights from Scotland. *Diversity*, 16, 195. <https://doi.org/10.3390/d16040195>
11. Fielding, Alan H., David Anderson, Catherine Barlow, Stuart Benn, Charlotte J. Chandler, Robin Reid, Ruth Tingay, Ewan D. Weston, and D. Philip Whitfield. 2024. The Characteristics and Variation of the Golden Eagle *Aquila chrysaetos* Home Range *Diversity* 16, no. 9: 523. <https://doi.org/10.3390/d16090523>

Consultancy

I have worked on many (>80) wind farm schemes almost exclusively with Haworth Conservation Ltd until Paul's death in 2018. Subsequently, I continued working as an independent consultant; analyzing data, calculating collision losses, advising on mitigation. I have also acted as an advisor to many wind energy proposals and have produced population and GET habitat loss models for local and cumulative impacts. I have very considerable experience of significant wind farm monitoring programmes (Edinbane, Clyde, Farr, Dumnaglass and Stronelaig).

I also provide advice to NatureScot (previously Scottish Natural Heritage, SNH) on matters related to wind farm environmental impact assessment either through commissioned reports or as a reviewer of other commissioned reports in my previous role as a member of the NatureScot scientific experts panel. I have delivered invited presentations on various aspects of environmental impact assessment at NS workshops. I acted as advisor to SNH during a planning inquiry relating to the potential impact of the proposed Stacain wind farm on Golden Eagles in an SPA.

Since 2017 I have been a member of the project team delivering an innovative approach to Golden Eagle conservation funded by SSE. It has already achieved its aims of increasing the size of the local Golden Eagle population but has also been influential in changing the local planning authority's (Highland Council) approach to wind farm planning permissions and has grown to include an education stream in addition to the research stream. Highland Council, NS and RSPB are also members of the project's management board. Currently, with Dr P. Whitfield (Natural Research Ltd), I am developing guidance for NS on reducing the impacts of wind farms and forest schemes on Golden Eagles. Once finalized, all wind farm developers will have to follow the guidelines if they are to obtain

permission for a wind farm or forest planting in regions occupied by Golden Eagles. This will replace current guidance on using the PAT model which we developed in 2002².

At the request of SNH, Paul Haworth and myself wrote an assessment of the potential for an expanded Golden Eagle population in the South of Scotland. Subsequently this resulted in the successful ongoing translocation programme. I am a member of the scientific advisory panel and regularly provide advice to the project.

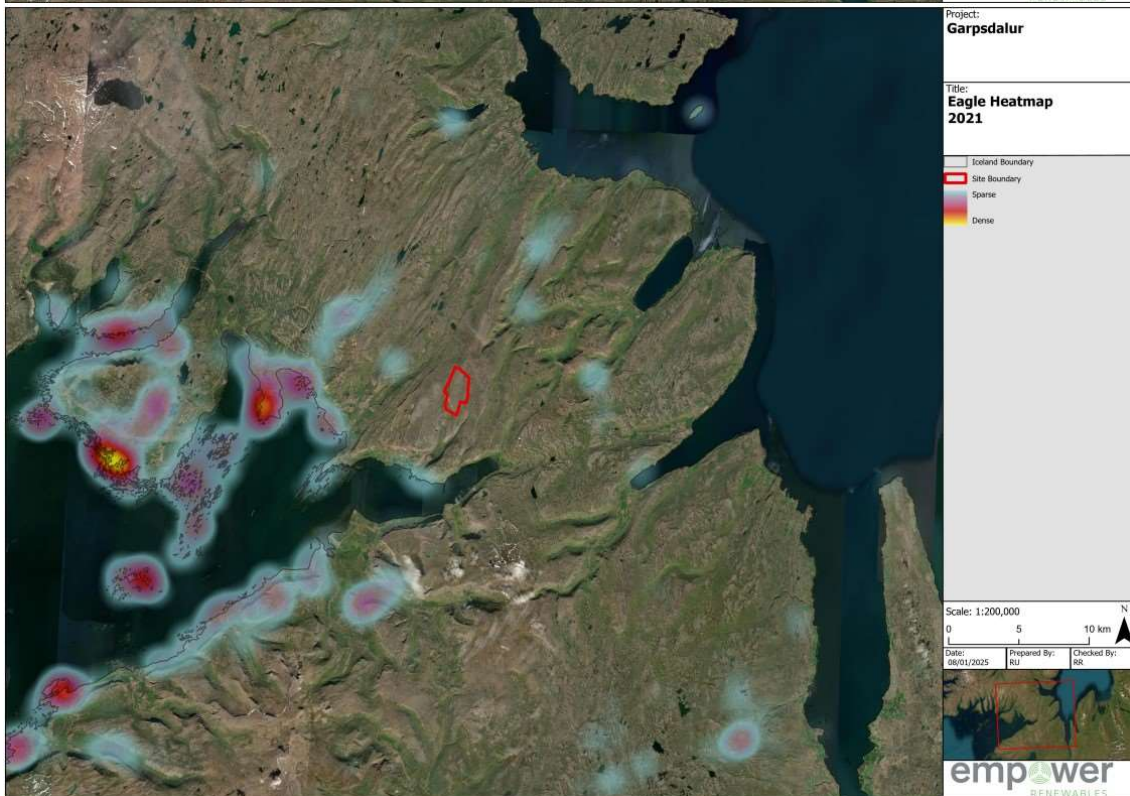
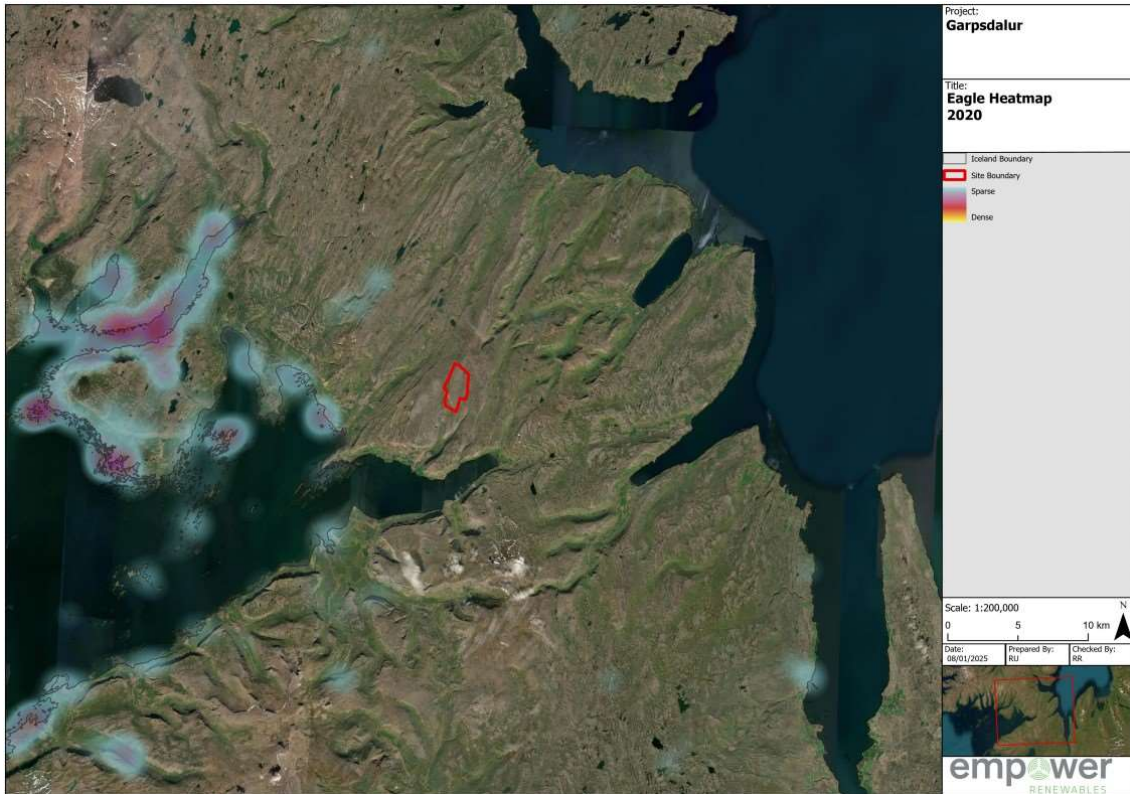
Phil Whitfield and myself completed a review, at the request of Scottish Government, of the evidence for the impact of illegal persecution of Golden Eagles in Scotland. This resulted in the grouse moor licensing legislation that has now become part of Scottish law.

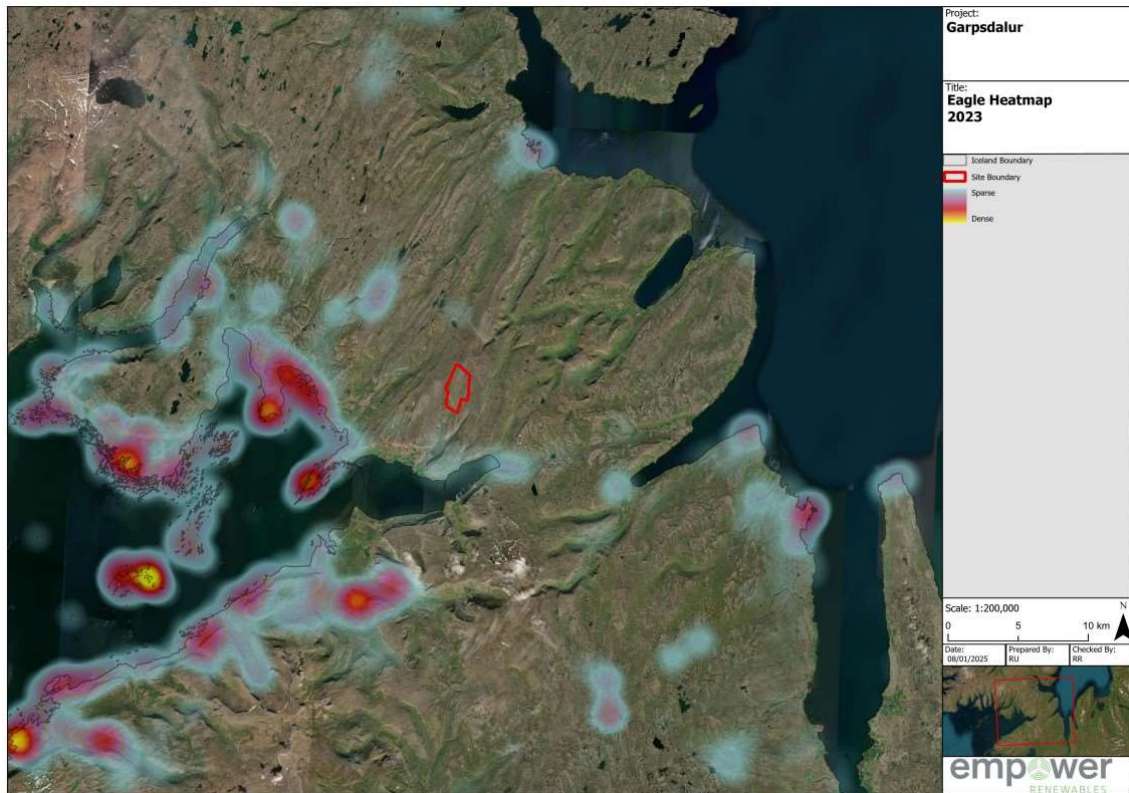
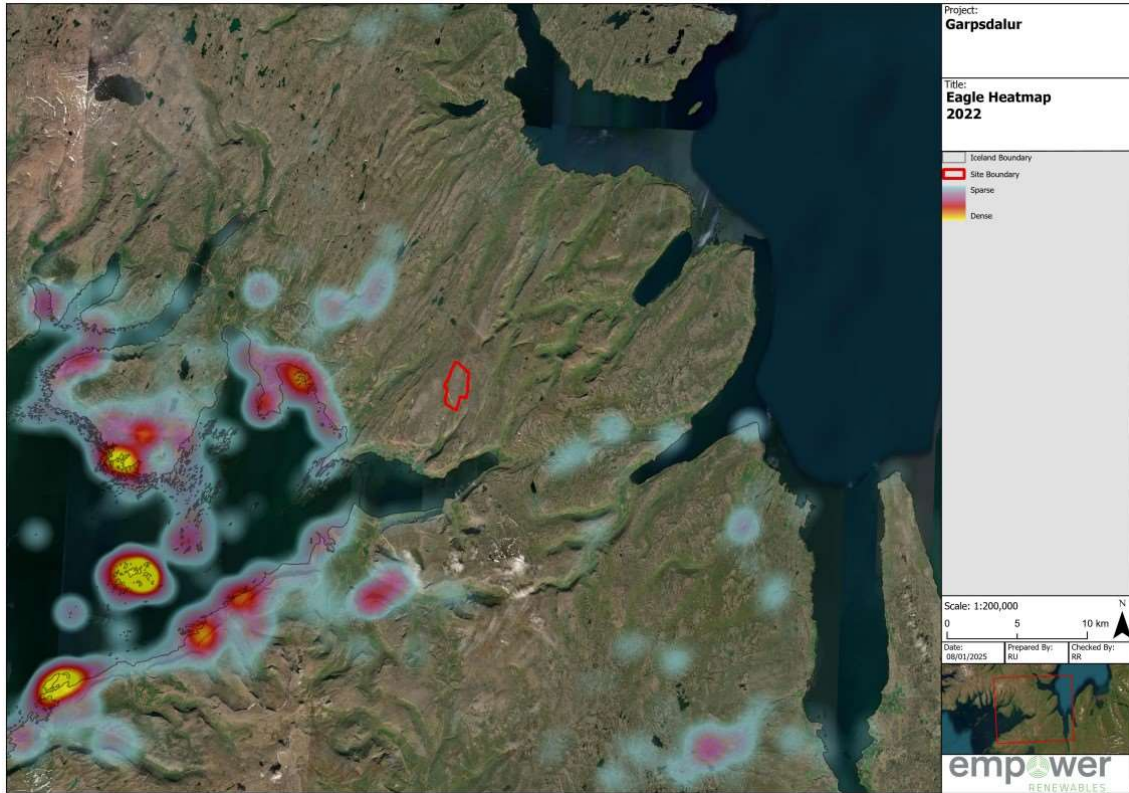
I am a founder member of the Golden Eagle and White-tailed Eagle Satellite Tagging groups (Natural Research, Wildland Ltd, Forest Enterprise Scotland, RSPB, SSE, Chris Packham, RPUK, Roy Dennis Foundation) and I collate data from all of the tags (>350) for use in ongoing research projects.

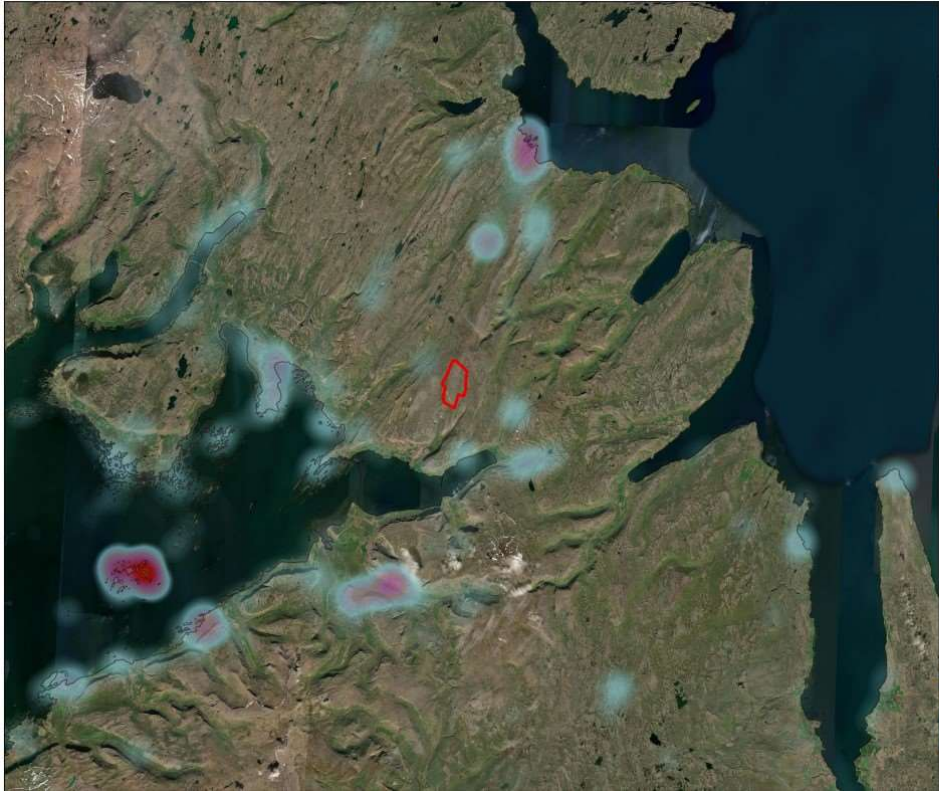
I am currently providing advice to the Cairngorm National Park to inform their future policy on raptor conservation and Forestry England (plus Natural England and DEFRA) on raptor conservation issues in England.

² <https://www.nature.scot/doc/naturescot-statement-modelling-support-assessment-forestry-and-wind-farm-impacts-golden-eagles>

Appendix – Heatmaps 2020 to 2024

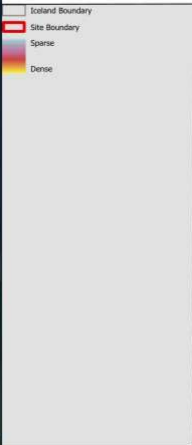






Project:
Garpsdalur

Title:
**Eagle Heatmap
2024**



Date: 08/01/2025 Prepared By: RU Checked By: RR

